

SHORT CASES ON PRODUCTION METHODS

Each of the ten short cases in this collection consists of a sketch and a brief description of a part and its use. Students are asked to suggest production methods, design changes to facilitate production, changes in dimensioning procedure and tolerances, etc.

## SHORT CASES ON PRODUCTION METHODS

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These cases are not intended as presentations of either good or poor engineering practice.

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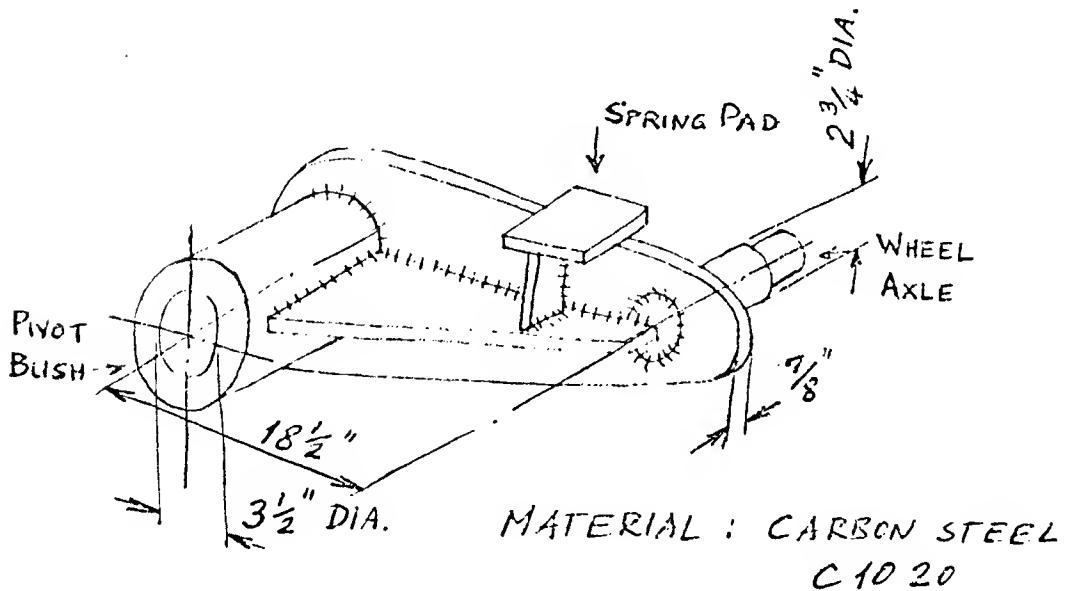
## Atkinson Forestry Co. (A)

As manufacturers of tracked vehicles, Atkinson are constantly searching for new markets. One of their latest ventures is a vehicle for forestry and transportation in alpine regions, with variants for snow and bog use. A prototype has already been tested and presented to the technical press. One of the crank arms for the idling wheels inside the track is shown in the figure.

The sales department has forecast a demand of 150 of these vehicles during the first year, and 300 per year for the next four.

## Questions:

- 1) Suggest alternative processes to manufacture this crank arm.
- 2) Which of these processes would you recommend for the stated quantities?
- 3) What would be the appropriate material specification?
- 4) What design changes are needed to allow your proposed manufacturing method to be used economically?



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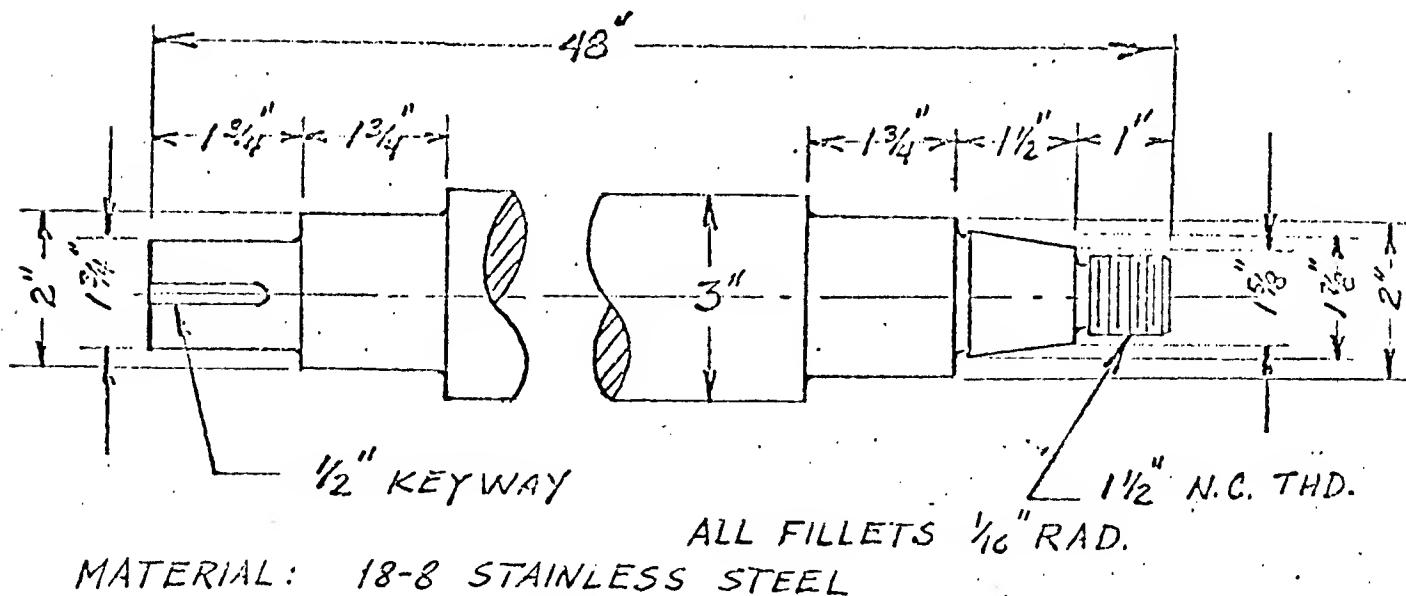
Worthing Rotary Co. Ltd.

As a manufacturer of rotary pumps since 1936, Worthing have recently introduced a new line of centrifugal pumps for natural gas pipelining in Britain. The gas is found offshore in the North Sea, or is delivered from LNG tankers to one of two terminals on the south coast.

Environment conditions in Britain are so severe, that Worthing considers stainless steel essential for its pump shafts. The shaft shown in the figure was used in a prototype pump. Worthing now have an order for 65 of these pumps.

Questions:

- 1) How, on what equipment, and with what tools would you propose to manufacture these shafts?
- 2) How does this method differ from the manufacture of the prototype shaft?
- 3) Is the dimensioning of the attached drawing adequate for manufacture and inspection? If not, what changes would you propose?



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## Toolroom Accessories Ltd.

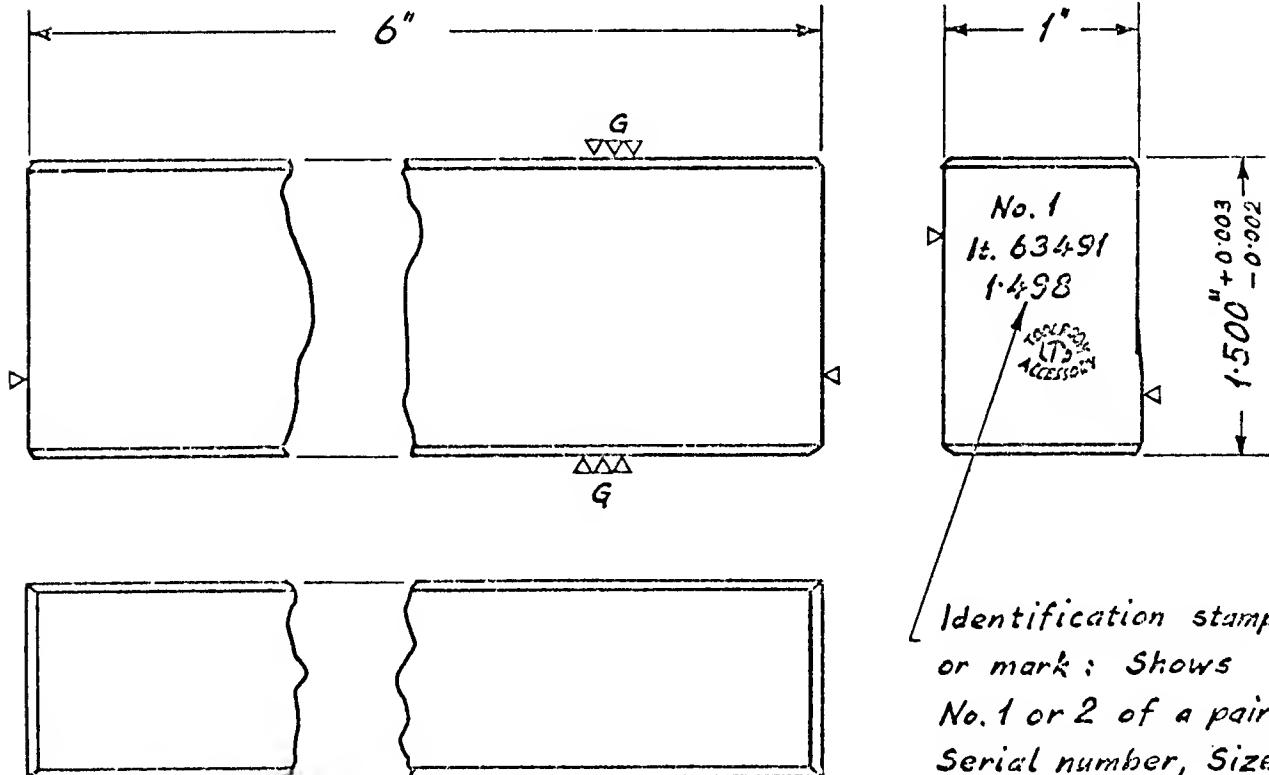
The Canadian prairie provinces are slowly being industrialized. An engineer recognized that toolroom skills and accessories would be needed in the early stages of progress, and he therefore founded this company.

Toolroom Accessories Ltd. has recently received an order for a number of hardened parallels of the type shown in the figure. They were to be case hardened and ground on the working surfaces. As the bars are to be used on milling machines or similar work devices, it is more important that they are a matched pair, i.e. that their thicknesses are within 0.0005 in. of each other, than that the thickness is within tolerance.

The first few bars that were delivered were returned by the customer as unsatisfactory. They invariably showed a lengthwise bow of up to 0.002 in.

## Question:

As engineer in charge of manufacture, specify the operations, illustrated where necessary by sketches, to manufacture these parallels and avoid the stated problems.



Identification stamp  
or mark: Shows  
No. 1 or 2 of a pair,  
Serial number, Size.

MATERIAL: C.H. STEEL

## Fenwick Transmissions Ltd. (A)

This company is well established in the manufacture of components and sub-assemblies for mechanical power transmissions. In the course of standardizing, they restricted their range of rigid flange-couplings in sizes from 1/2 to 2 in. shaft diameter to steps of 1/8 in.

A customer has now asked for quotations on rigid couplings for 1 3/16 in. shafts, namely an initial trial quantity of 10 couplings, with an order of 5000 if the first batch are satisfactory. The alternatives to be quoted are: (1) for clearance bolts to hold the coupling halves together and transmit torque by friction between the faces bounded by diameters D and J, and (2) close-tolerance bolts to transmit torque primarily by shear of the bolt shanks.

## Questions:

- 1) As methods engineer, you are asked to specify how the positions of the holes will be located to prepare for the drilling operation.
- 2) What alterations, if any, would you suggest in this design?

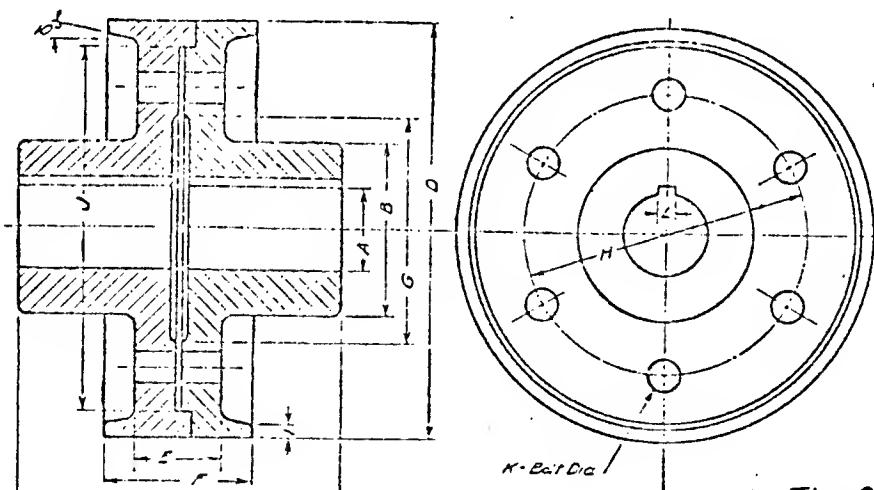


Fig. 2

| A   | B   | C   | D | E   | F   | G     | H | I    | J   | K   | L   |
|-----|-----|-----|---|-----|-----|-------|---|------|-----|-----|-----|
| 1/8 | 1/2 | 5/8 | 6 | 1/2 | 5/8 | 1 5/8 | 4 | 1/16 | 5/8 | 5/8 | 1/4 |

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## Swansey Aircraft Co.

Mr. Hugh Evans, personnel officer, has recently been asked to recruit three persons to be trained as part-programmers for the company's numerically controlled milling machines.

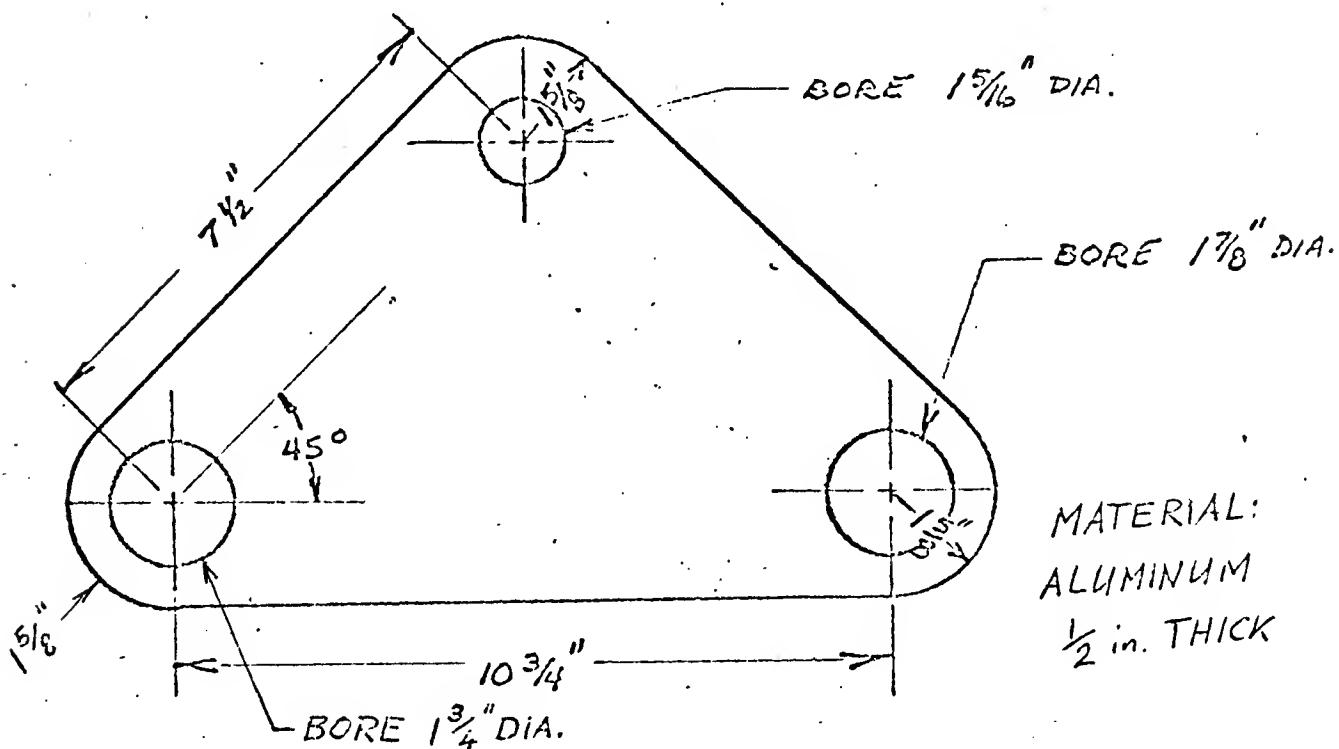
The company has been manufacturing light aircraft for pleasure flying since 1952. They have recently installed one straight-line and one contour 2D milling machine, as well as a drill. Company policy has been to attract personnel with some experience, and then to give training in their specific techniques.

Mr. Evans has set up the following test to select the required persons:

Write a brief description of how the component shown in the figure might be programmed for a numerically controlled milling machine. Outline how the geometry could be described, and what motions the tool would take. State the general capabilities required of the milling machine to be used for this piece.

## Questions:

- 1) Perform the test as outlined above.
- 2) Would this test be useful in selecting personnel?



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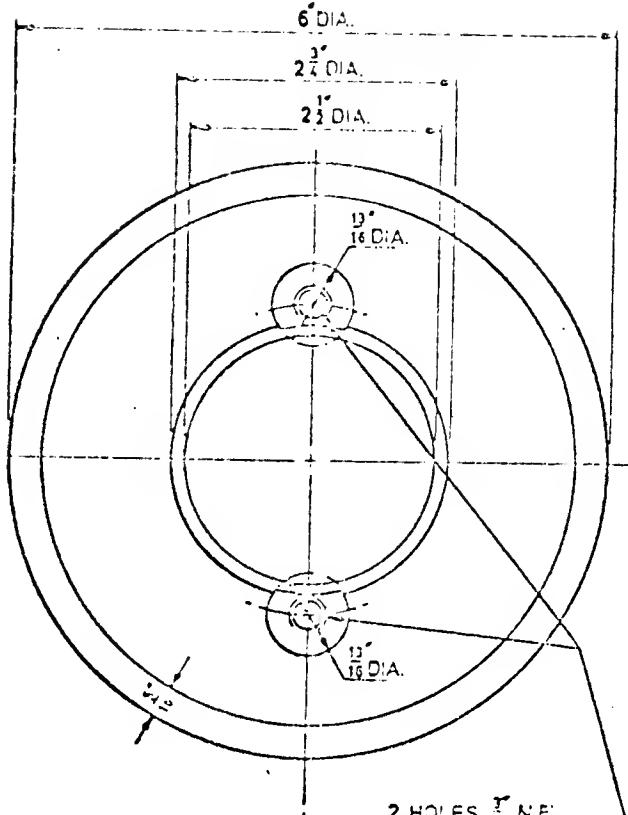
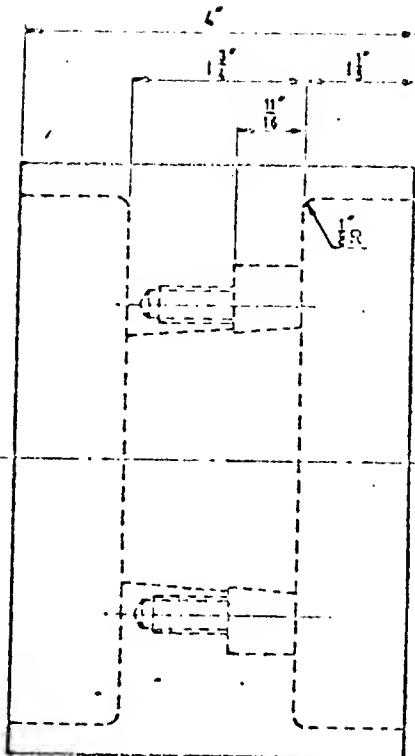
## Fenwick Transmissions Ltd. (B)

A new method of fixing belt pulleys and gear wheels to shafts has been devised by Fenwick design engineers. They intend to use the trade name TAPERLOCK. The components are shown in the accompanying figure. An initial quantity of 2000 taperlock bushes and 100 pulleys are to be made.

## Questions:

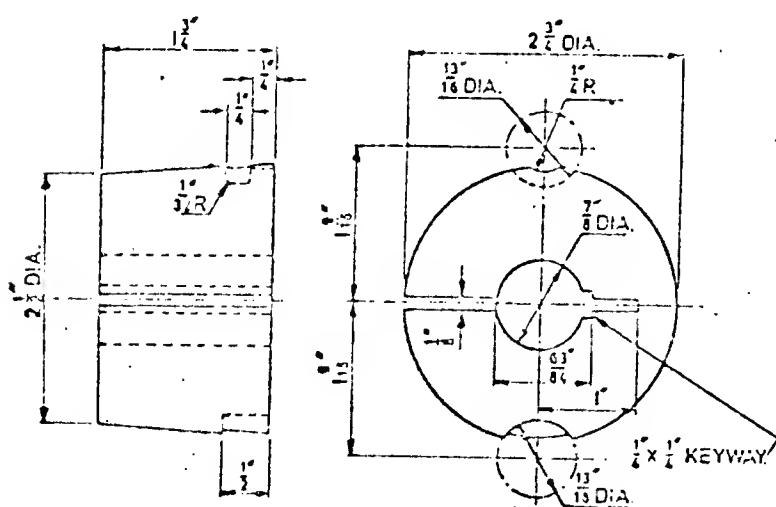
- 1) describe suitable methods of manufacture for the components of this pulley
- 2) describe jigs and fixtures needed
- 3) add tolerances to critical dimensions and describe how these would be inspected.

(See page 7 for figure)

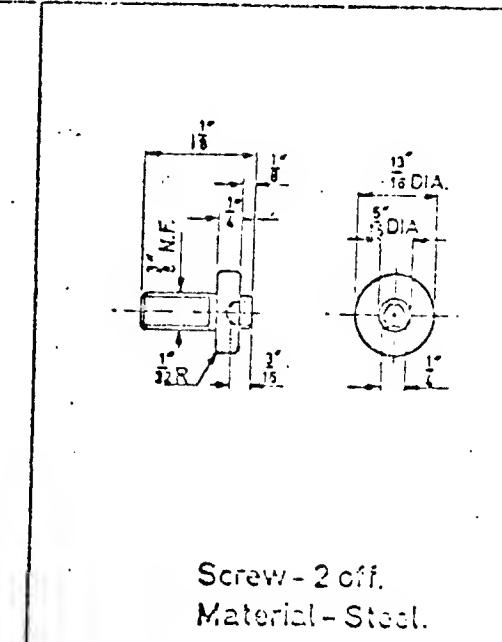


PULLEY - 1 off.  
Material - Cast Iron, G 3000

2 HOLES  $\frac{1}{2}$  I.N.F.  
 $\frac{1}{2}$  DEEP ON  $3\frac{1}{2}$  P.C.DIA.



Tapered Bush - 1 off.  
Material - C1040 Steel.



Screw - 2 off.  
Material - Steel.

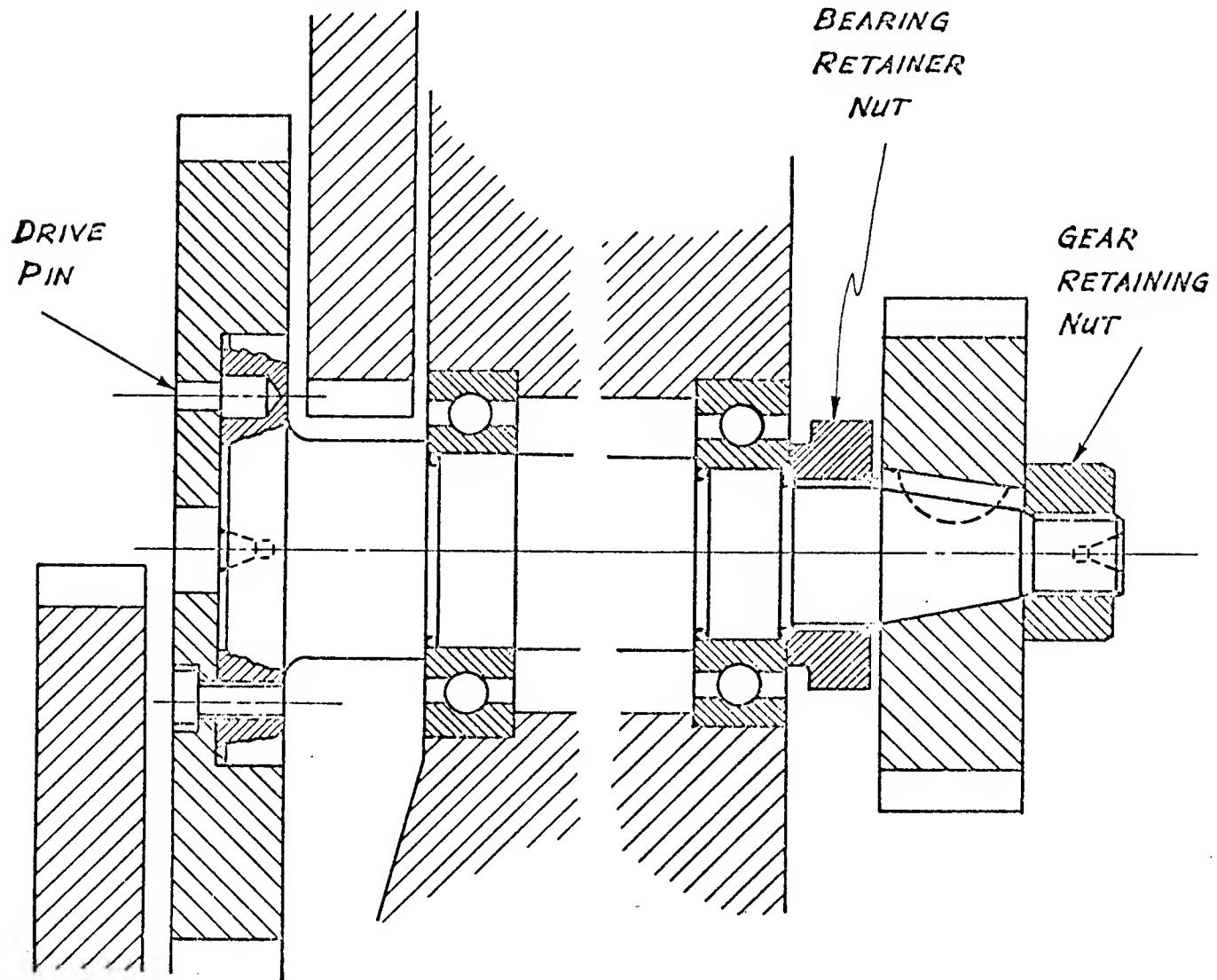
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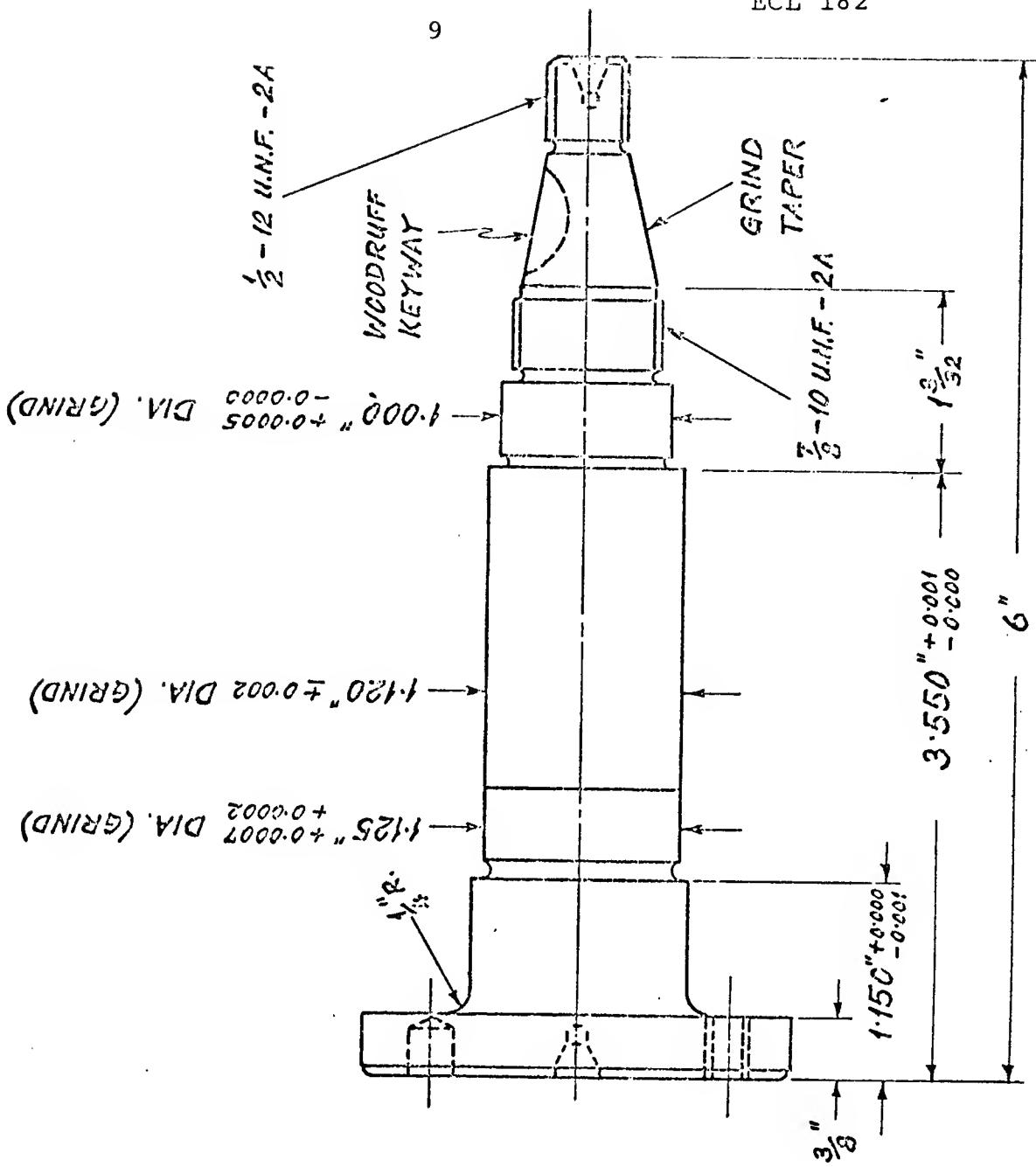
## Atkinson Forestry Co. (B)

One of the auxiliary drives for the prototype tracked vehicle mentioned in case (A) (page 1) has an output shaft arranged as in Figure 1. This shaft was case hardened. The detail drawing is shown in Figure 2.

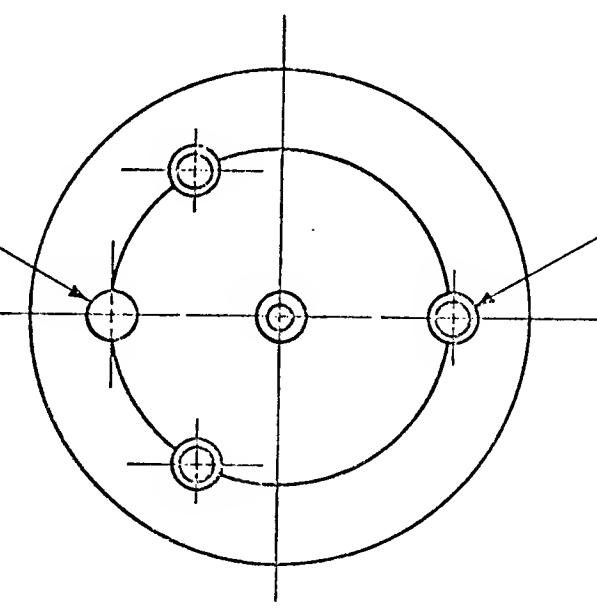
## Questions:

- 1) What sequence of manufacturing processes would be used to make this shaft?
- 2) How could hardening of the screw threads be prevented? What other features should be protected from hardening?
- 3) What alterations, if any, would you propose for the larger quantities expected? How does this affect the proposed manufacturing sequence?





*DRIVE PIN HOLE  
SPOT FROM GEAR  
DRILL & REAM  
/  $\frac{1}{4}$ " DIA.*



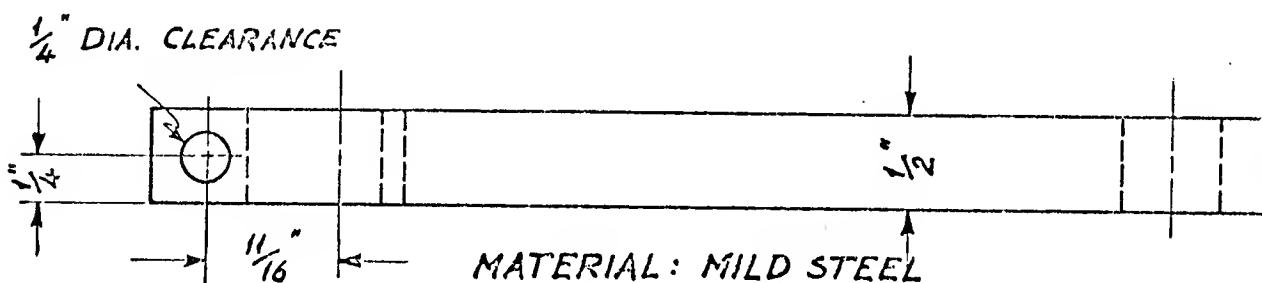
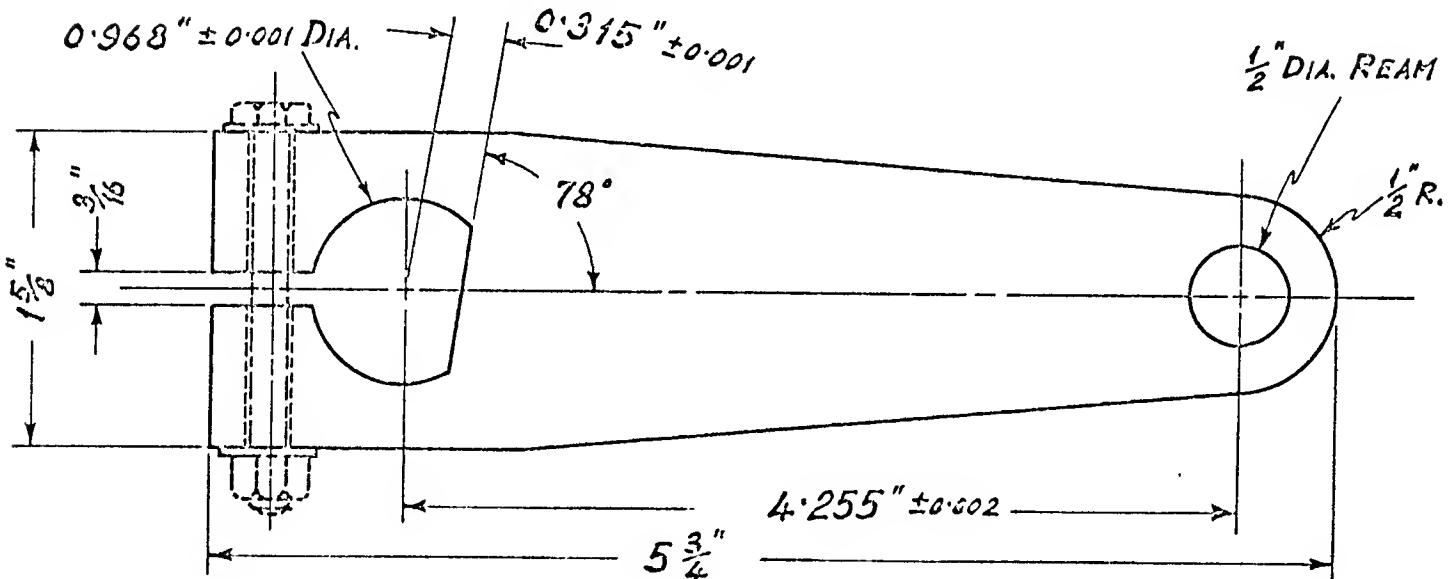
3 HOLES, DRILL  
& TAP  $\frac{1}{4}$ " N.F.  
EQUALLY SPACED  
ON 1  $\frac{3}{4}$ " P.C.D.

Hack and Plough Agricultural Machinery Co.

A young draftsman has produced the detail drawing shown below. It is for a control lever, to be clamped by a pinch bolt (shown in phantom view) onto a shaft which has an appropriate flat machined onto it. The lever is for a special-purpose machine to be produced as a one-off item. Our draftsman envisaged flame cutting to produce the blank for this lever.

Questions:

- 1) Would you accept this drawing? Give reasons.
- 2) How would you manufacture the required control lever?



**Vario Speed Gear Company Ltd. (A)**

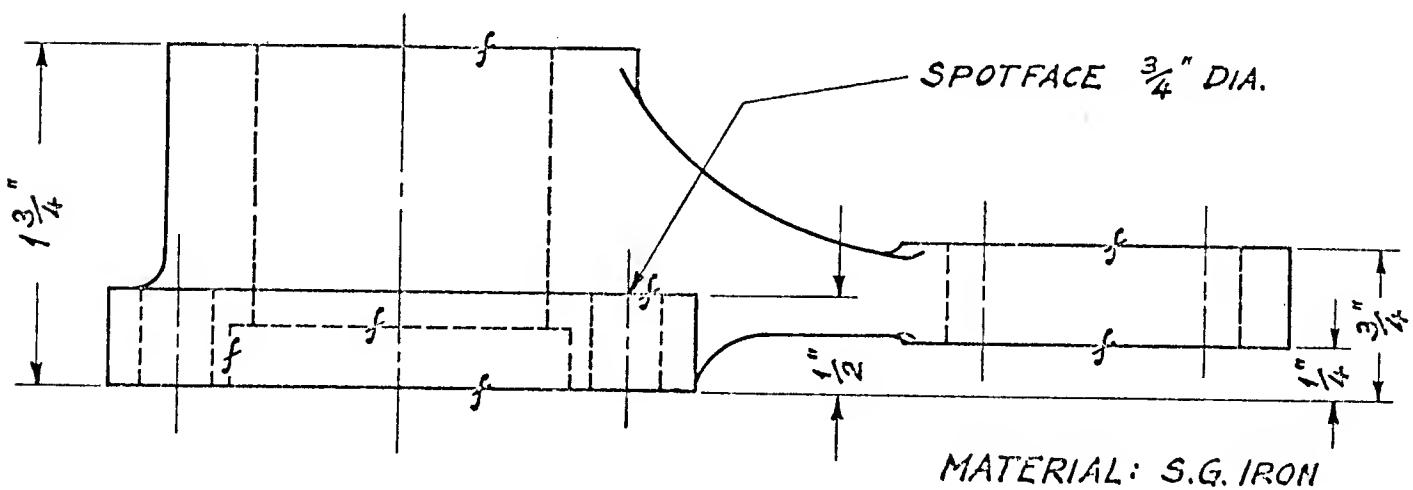
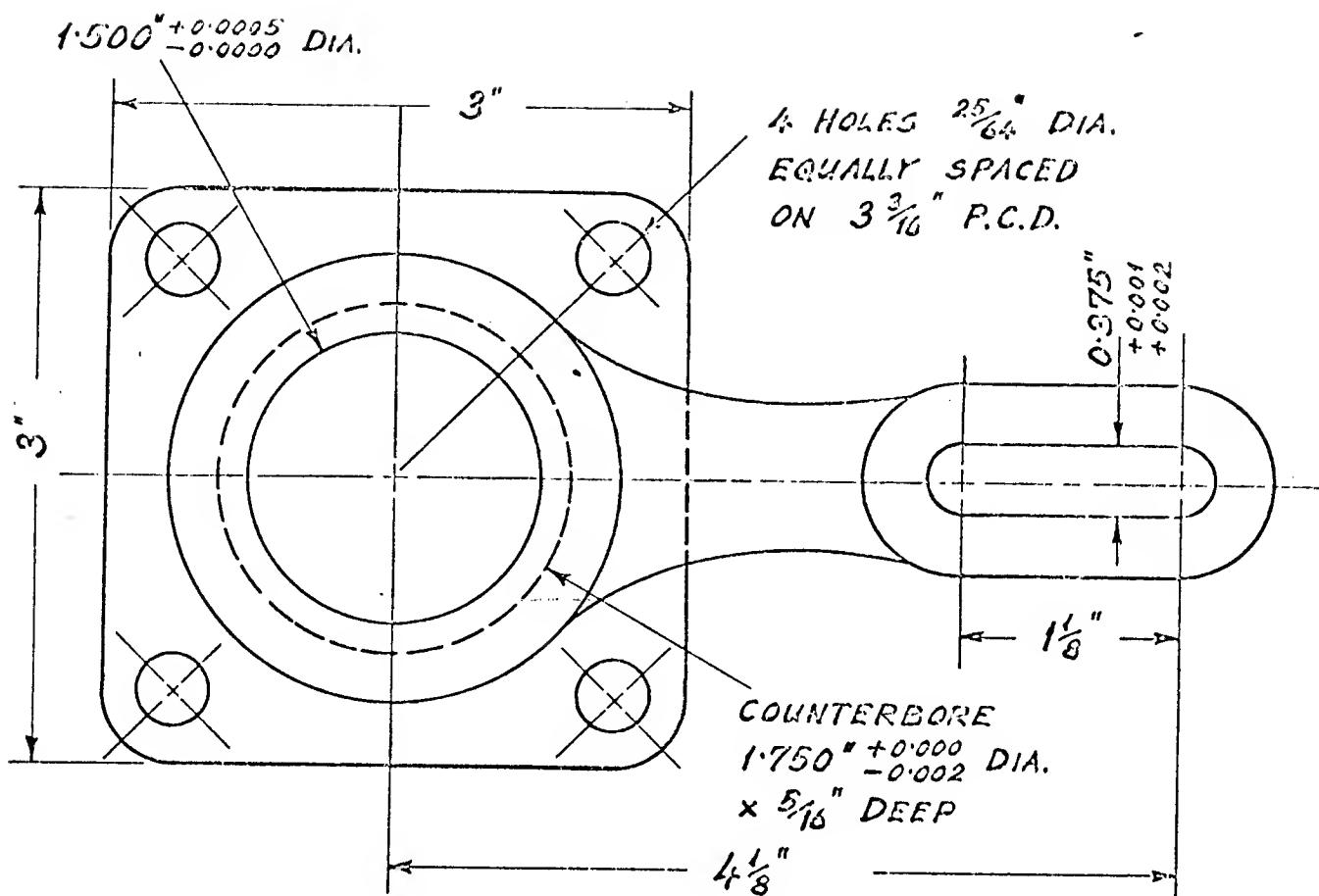
As one of the more progressive companies in the area of mechanical transmissions, Vario Speed have introduced a number of mechanical continuously variable speed gear boxes. A customer has now requested a variable speed gear with a lever control moving concentrically around the output shaft. The necessary lever is shown in the figure below.

Vario Speed now intend to manufacture a prototype.

**Questions:**

- 1) What information is missing from this drawing?
- 2) What manufacturing sequence would you propose for this component?

(see page 12 for figure)



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**Vario Speed Gear Company Ltd. (B)**

The prototype box from the previous case was successful. Our customer has ordered 35 units to be delivered within three months, with prospects for further orders of similar size at approximately six month intervals.

**Questions:**

What jigs or fixtures should be made to assist in manufacturing the lever control shown on page 11? How do these affect the proposed manufacturing sequence?